Elective Modules: Inorganic Chemistry

1	Elective Module: Inorganic Materials	SKS	ECTS-Credits
	In this elective module some inorganic materials such as carbon nanostructures and its allotropes, inorganic polymers, silica-based materials will be discussed including its chemical and physical properties, structure, synthesis and characterization, and further application.		
a	**Carbon Nano Structure (II)** This course discusses about nanostructured carbon materials, their physical and chemical properties, aspects of symmetry and its crystallinity; allotrope structure of carbon, properties (physical, chemical, mechanical, electrical, etc.), manufacturing process and application of graphite, diamond, fullerenes, carbon nanotubes, carbon fiber and amorphous carbon, and characterization of structured carbon nano-materials.	2	2.66
b	**Inorganic Polymer (I)** Definition and concept of inorganic polymers, types of inorganic polymers (homopolymers, heteropolymers). Polymerization and depolymerization. Catenation and alteration. Development of polysiloxane, silica-based polymer, Polysilane, Polypospazene. Structure, chemical and physical properties of polymers, and the recent development of synthesis, modification, and application of inorganic polymer are also discussed.	2	2.66
c	**Silica-based Material (II)** This course will cover about the natural occurred silica material and Synthetic based silica material, innovation and modification of the material, characterization and application related to silica material in industrial field, basic research, and medical application and so on.	2	2.66
d	**Inorganic Material** The course will focus at atomic structure, phase diagram, thermal properties of optical electric magnets, properties and manufacture of porous materials, plated, nano, liquid crystal.	2	2.66
	Total	8	10.64
	Learning Outcomes: LO 1. Students have ability to become professional experts in the industry, academic, and other relevant fields. LO 2. Students have ability to apply scientific methods in chemistry and other fields.		

	LO 4. Mastery of basic principles and ability to use the software in determining the structure and energy of micro molecules, analysis, and synthesis in general or more specific fields in chemistry (organic, biochemistry, or inorganic), and data processing (analytical chemistry). LO 6. Students master the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micro-and micro molecular compound and their application.
	Prerequisites: Compulsory module of Inorganic Chemistry

2	**Elective Module: Synthesis of Inorganic Materials**	**SKS**	**ECTS-Credits**
	In this elective module basic concept of inorganic synthesis will be discussed. Some synthetic method for inorganic compound such as organometallic compounds, via building bock approach, template, self-assembly, high dilution method and so on and its coordination chemistry will be delivered. The reaction mechanism during the synthesis with or without the presence of catalyst for instance will be studied in understanding the how the reaction take place.		
a.	**Inorganic Synthesis (I)** This course will discuss about the concept of ligand synthesis, synthesis of metal-complexes, inorganic compounds (such as metal oxide, inorganic macro-molecule and so on), their characterization and applications to several field such, as catalysis, biomedical, and environment. Data processing and interpretation using updated journal will be used as practices.	2	2.66
b	**Coordination Chemistry (II)** This lecture will discuss about the formation of coordination compounds and the procedure for naming them according to IUPAC, understanding how to characterize coordination compounds such as the properties of UV, IR spectra, TG/DTA data, magnetic moments, and the strategy to synthesize the coordination compound, geometry of coordination compounds, equilibrium and chemical kinetics of coordination compounds.	2	2.66
c	**Organometallic chemistry (II)** Basic concept of organometallic chemistry: crystal and ligand field theory, back bonding, electro neutrality, ligand types. Organometallic compounds with sigma-bond ligands: metal-alkyl, metal-aryl, metal hydrides, metal- (CO, RNC, CS, NO), metal-phosphine and their	2	2.66

	derivatives. Organometallic compounds with π-bond ligands: alkene complexes, alkyne complexes, allyl complex, diene complex, Cp complex, arene complex, alllylcyclic complex, stability of polyene and polyenyl complexes. Organometallic reactions and its characterization: ligand substitution reactions, oxidative addition and reductive elimination reactions, insertion and elimination reactions, nucleophilic addition reactions, electrophilic addition and abstraction. Applications of organometallic complexes: homogeneous and heterogeneous catalysts, biomedical and so on.		
d	**Inorganic Reaction Mechanism (I)** An overview of inorganic reaction mechanisms: theory of chemical kinetics, reaction rates and mechanisms, steady state approach at reaction equilibrium. The role of solvent and ion solvation. Inert complexes and labile complexes, collision theory between molecules, transition state theory, and ligand substitution reaction mechanisms include the principles of ligand substitution reactions (acid-base strength, Le Chatelier's principle, chelating effect, and steric effect), association, and dissociation and interchange mechanisms. Substitution reactions in octahedral complexes substitution reactions in square planar complexes and substitution reactions in tetrahedral complexes, electron transfer reaction mechanism (inner sphere reaction mechanism and outer sphere reaction), addition reaction mechanism oxidative and reductive elimination, photochemical redox reaction mechanism, metal ion redox process as a catalyst and binuclear complex reaction mechanism.	2	2.66
	Total	8	10.64
	Learning Outcomes: LO 1. Students have ability to become professional experts in the industry, academic, and other relevant fields. LO 2. Students have ability to apply scientific methods in chemistry and other fields. LO 6. Students master the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micro-and micro molecular compound and their application.		
	Prerequisites: Compulsory module of Inorganic Chemistry		

3	**Elective Module: Recent Trend in Inorganic Chemistry**	**SKS**	**ECTS-Credits**
	In this elective module some recent trend in inorganic chemistry such as membrane chemistry and membrane technology, nanotechnology and nanomaterial, bio-inorganic chemistry, supramolecular chemistry, and geochemistry will be discussed. The lectures will cover the current state of the topic and update research of each area of the lectures.		
a.	**Membrane Technology (I/II)** This course will cover Classification several type of membranes, membrane fabrication, structure of material and its modification for membrane application, Membrane characterization, application of membrane technology (in water treatment, medical and other environmental applications).	2	2.66
b.	**Nanotechnology and nanomaterial (I)** Introduction to nanotechnology and nanomaterials, molecular interactions, nanostructured materials, the basic principles of nanotechnology, size effect quantum. Effect of material size, fundamental techniques in nanomaterial fabrication, nanomaterial development: dimensions of nanomaterials (0D, ID, 2D and 3D), development of nanomaterials and their applications: Nanoparticles, Quantum dots – nanocrystals, Metallic nanoparticles, Metal oxide nanoparticles, Magnetic nanoparticles, Fluorescent material, Carbon based nanomaterial (Spherical carbon, Fullerenes, Carbon nanoparticles, carbon spheres, Hollow, Core-shell, Carbon onions, Carbon helices – carbon microcoils, Carbon nanocones, Carbon nanohorns, Carbon nanofoam, Carbon nanotubes, Carbon nanofibers, Nanofluids and Nanofilm materials. Composite nanomaterials: Composite nanoparticles, Composite nanowires & nanotubes, etc. Functionalized nanomaterials, Material characterization and applications.	2	2.66
c.	**Bio Inorganic Chemistry (I)** History and concept, bio metal and bio ligand, coordination chemistry, biophysical method, structure and function of metallo-protein, metallo-enzyme, oxygen transport, electron-transfer protein.	2	2.66
d.	**Supramolecular Chemistry (II)** History and concept, host-guest chemistry, non-covalent interaction, ionophore, anion recognition, anion-cation recognition, neutral	2	2.66

	guest, analysis method, self-assembly, application, actual research topic (MOF, COF, molecular imprinting etc).		
e.	**Geochemistry (I)** This course discusses about the structure and composition of the universe, the solar system, the earth: the structure and composition of the earth, hydrosphere, atmosphere, rocks, magma and igneous rocks, sedimentation and sedimentary rocks, metamorphic processes and metamorphic rocks and geochemical cycles.	2	2.66
f.	**Plasma Chemistry (II)** This course explain about plasma and plasma chemistry, examples of plasma in nature, types of plasma and their applications, glow discharge plasma further, basic processes and mechanisms, formation of plasma, basic reactions in plasma, properties of glow discharge plasma including temperature and density plasma, its electrical and optical properties, the properties of glow discharge plasma include electrical and thermal conductivity and their magnetic properties, scientific discussion related to the wide use of plasma in industrial applications, plasma chemistry in the synthesis of organic and inorganic components/materials, surface interactions with plasma species, plasma applications processing for surface modification, plasma chamber design.	2	2.66
	Total	12	15.96
	Learning Outcomes: LO 1. Students have ability to become professional experts in the industry, academic, and other relevant fields. LO 2. Students have ability to apply scientific methods in chemistry and other fields. LO 3. Students Master in theory and working as a researcher in the field of science and technology with the ability to solve community problems with an orientation to sustainable development and to disseminate research results in scientific meetings and scientific publications. LO 5. Student have expertise in practical work in the laboratory, handling general and special chemicals, and implementing work safety and security systems. LO 6. Students master the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micro-and micro molecular compound and their application		
	Prerequisites: Compulsory module of Inorganic Chemistry		